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Dysmenorrhea and its association with academic performance among graduating university students.

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Abstract

Objectives: This is the first attempt to provide association between dysmenorrhea and academic performance. Further, the study aims to determine the prevalence and risk factors of dysmenorrhea.

Design and method: Institution based cross-sectional study was conducted from April 1 to 28, 2019. A semi-structured and pretested self-administered questionnaire was used to collect data. Binary logistic regression analysis and one-way analysis of variance (ANOVA) were performed to model dysmenorrhea and academic performance, respectively.

Setting and Participants: Ethiopia (2019: n = 647 female university students)

Outcomes: The primary outcome is dysmenorrhea, which has been defined as a painful menses that prevents normal activity and requires medication. The self-reported cumulative grade point average (CGPA) of students was used as a proxy measure of academic performance, which is the secondary outcome.

Results: The prevalence of dysmenorrhea was 317(51.5%). Educational status of father (AOR (CI) =2.64(1.04-6.66)), chocolate consumption (AOR (CI= 3.39(1.28-8.93)), daily breakfast intake (< 5 days/week) (AOR (95% CI) = 0.63(0.42-0.95)), irregular menstrual cycle AOR (CI) = 2.34(1.55-3.54)) and positive family history of dysmenorrhea AOR (CI) = 3.29(2.25-4.81)) had statistically significant association with dysmenorrhea. There was no statistically significant difference in academic performance among students with and without dysmenorrhea (F (3,611) = 1.276, p = 0.28)).

Conclusions: Dysmenorrhea was common among graduating university students. No statistically significant difference in academic performance was observed among students with and without dysmenorrhea. Medias and reproductive health offices better to promote the community to reduce the use of high sugar-containing meals, including chocolates, and support students to have a regular follow up of their menstrual pattern and seek care in case of irregular periods.

Strengths and limitations of this study

- To our knowledge, this is the first study to provide the association between dysmenorrhea and academic performance.
- A standardized Multidimensional Scoring System (MSS) was used to diagnose dysmenorrhea.
- The nature of cross-sectional study does not allow causal relationship.
- Self-administered data collection was applied that might add social desirability bias.
- The nature of self-perceived reporting may have resulted in recall bias and over/under-reporting of some variables.

Introduction

Dysmenorrhea also called painful periods or menstrual cramps, is a recurrent, crampy pain that occurs during menstruation. It can be either primary without visible pelvic pathology, or secondary with an identifiable pelvic disorder (1, 2). The mechanisms of menstrual cramps are believed to be caused by hyper-production of uterine prostaglandins, particularly of prostaglandins F2α, which results in myometrial hyper-contractility and arterial vasoconstriction (2). Compared to non-dysmenorrheic women, those women with dysmenorrhea have higher levels of prostaglandins, especially within the first two days of menses (3). The uterine activity seen during the severe period is more intense than that seen in labor and results in intrauterine pressures well above tissue perfusion thresholds (4).

Dysmenorrhea is one of the most frequently happened gynecologic disorders among adolescent girls. Globally estimates of the burden of dysmenorrhea ranges from 50 to 95 percent (5, 6). This might be due to studies conducted among different age groups, the use of different definitions and/or the absence of a standard method for measuring the severity of pain (7). The highest prevalence was reported from Egyptian university students, in which 93% of them had painful menstruation (5), and followed by 89.1% of Iran University students (8). In Ethiopia, a study among Mekelle University students stated the burden of dysmenorrhea as 71.8% (9).

Dysmenorrhea is responsible for substantial financial losses, that extends beyond the individual level to the future generations, due to the cost of medications, medical care, impaired daily activities and decreased productivity (10). Among women affected by dysmenorrhea, about 15 to 20% of them were unable to perform their normal day to day activities during each menstrual period (2). For instance, in the US, around 140 million working hours are lost annually due to dysmenorrhea (11). Even those women who desire to work during their cramps have been shown to have lower work output. In addition, in Japan, an estimated $4.2 billion dollar economic losses occur as a result of dysmenorrhea (12). In addition, it remains an important cause of recurrent short-term school and work absenteeism, and poor quality of life (10, 13-16).

Dysmenorrhea not only affects the daily activity and socio-economic status but also associated with future risk of hyperemesis gravidarum (HG). A study from the State University of New York stated that women with a history of adolescent and adulthood dysmenorrhea were five

times more likely to develop HG. The risk increases by ten-fold for severe dysmenorrhea (17). These were due to the assumption that the prostaglandin and cytokine-induced nausea and vomiting in severe dysmenorrhea are affiliated with excessive nausea and vomiting seen on hyperemesis patients. Thus, early diagnosis and treatment of severe nausea and vomiting in patients with a history of severe dysmenorrhea play a role in reducing the morbidity associated with HG (18).

Despite its common occurrence and significant impacts on day to day activities, many women fail to report pain and/or seek medical treatment and hence, it is under-diagnosed and undertreated (7, 19). Only 14.2% of females seek medical care/advice, which indicates the importance of screening all adolescent girls for menstrual cramp (19, 20).

Heedlessly, dysmenorrhea persists invisible and given low priority in most parts of the globe including Ethiopia compared to other health problems. So that, attention needs to be given for better prevention and management practices, and hence to improve the quality of life, productivity and academic performance of the leaders of tomorrow, adolescent girls (7). Limited studies to date have been done to address the relationship between dysmenorrhea and academic performance in developing nations including Ethiopia. Hence, the study attempted to assess the burden, associated factors and temporal association between dysmenorrhea and academic performance in South Ethiopia.

Research questions

1. What is the magnitude of dysmenorrhea?
2. What are the factors associated with dysmenorrhea?
3. Does dysmenorrhea have a statistically significant association with the academic performance of students?

Research hypothesis

- There is no statistically significant association between dysmenorrhea and the academic performance of students.

Methods

Study area and period

A cross-sectional study among female Hawassa University students was conducted from April 1 to 28, 2019 GC. Hawassa University is one of the oldest and well-established universities in Ethiopia. During the study period (2019/20), the university had a total number of 21,579 students of which 7,955 were female. About 2118 female students were graduating class of 2019 GC. The university has one institute (Institute of Technology) and ten colleges. Totally, 8 colleges and 1 institute, organized with 75 departments had graduating class students.

Sample size determination

The required sample size was computed using Open Epi version 3.03 statistical software. The following assumptions were considered: proportion 66.8% (21), 95% confidence level, 5% level of significance, power 80%, margin of error, d = 5%, design effect, d = 2, and 10% non-response rate. By considering, the final sample size was 647.

Sampling technique and procedure

The study participants were selected from all-female graduating Hawassa University students using a multistage stratified sampling technique. First the colleges were stratified in to two: medical and non-medical. Then, four colleges were selected from non-medical colleges using simple random sampling (SRS) and the calculated sample size was distributed to each of the selected medical and non-medical colleges using probability proportional to size (PPS). In each of the selected colleges again departments were selected using SRS. Then, in the selected departments, the required sample size was proportionally allocated based on the number of total graduating students. Finally, from all graduating students of the selected departments, SRS was done to pick the required sample size using a pre-determined sampling frame of all departments where the samples were selected. Students who were not regular and who were not willing to fill the questionnaire were excluded.

Data collection tool and procedure

Data was collected using a semi-structured self-administered questionnaire. The questionnaire was prepared with reference to previous, similar published literatures (9, 22-24). Then it was

modified and contextualized to fit the local situation and the research objectives. The questionnaire was prepared in English and later translated to the local language, Amharic and then back to English by different translators, to keep the consistency of the questionnaire.

Data quality control

A pre-test was conducted on 5% of the total sample (32 students) in Dilla University and necessary amendments were considered following the result of the pretest. Four BSc midwives facilitated the data collection. Two MPH students were recruited for supervising facilitators. Training was given for data collectors and supervisors for one day regarding the objectives, methodologies, data collection techniques and ways to approach the participants. The supervisors were checking the day-to-day activities of data collectors regarding the completion of questionnaires, clarity of responses and proper coding of the responses. There was continuous supervision to control the data collection procedure by the principal investigator.

Data management and analysis

The data were checked for clarity, completeness and consistency. Epi-Data version 4.6 and SPSS version 20 were used for data entry and analysis, respectively. The descriptive statistics were presented using texts, frequency tables, graphs, mean, and percentages. Multicollinearity between the variables was also checked using tolerance and variance inflation factor (VIF). Bivariable and multivariable logistic regression analysis was performed to identify independently associated factors of dysmenorrhea. One-way analysis of variance (ANOVA) test of association was applied to examine the mean difference in academic performance among students with and without dysmenorrhea. The strength of association was interpreted using adjusted odds ratios with 95% confidence interval and the Hosmer-Lemeshow goodness-of-fit was applied to test for model fitness. Statistically significant variables were declared at a p-value of ≤ 0.05.

Measurement

Dysmenorrhea: was considered if the girl had painful menstruation, unable to perform daily activities and needs medical management or self-medication to control pain for the past 6 months (25, 26).

Academic performance: the self-reported cumulative grade point average (CGPA) of students were used as a proxy measure of academic performance (27).

Multi-dimensional Scoring system (MSS): is a scoring system that grades pain severity and took into account the impact of pain on daily activities, systemic symptoms, and analgesic requirements (28).

Grade 0 (no dysmenorrhea): menstruation is not painful and daily activities are not affected.

Grade 1 (mild): menstruation is painful but seldom inhibits normal activity. Pain killers are rarely required.

Grade 2 (moderate): painful period and affects daily activities. Pain killers are required; however, they give sufficient relief so that absence from class is unusual.

Grade 3 (severe): is a painful menses that severely limit normal daily activities and results in noticeable symptoms (such as headache, fatigue, vomiting, and diarrhea) and refractory to analgesics.

Patient and public involvement

There was no patient and public involvement in the design and planning of this study.

Ethical consideration

Ethical approval was obtained from the institutional review board of Hawassa University, college of medicine and health science (Ref. No: IRB/210/11). Verbal informed consent was obtained from the study participants. Data was kept confidential and anonymous, and were used only for research purposes.

Result

A total of 615 female students were participated in the study, making a response rate of 95.1%. Thirteen (2.0%) respondents had lack of interest and shortage of time, and the rest 19(2.9%) questionnaires were found to be incomplete and excluded from the analysis.

Socio-demographic characteristics of participants

The age of the participants ranged from 18-29 years with the mean age of 21.68±2 (SD) years and more than half 380(61.8%) of the respondents were found in the age range of 21 - 25 years. Most of the respondents 422(68.6%) were followers of Orthodox Christianity and three-fourth, 462(75.1%) of students earn more than 301 Ethiopian birr per month (Table 1).

Table 1: Sociodemographic characteristics of the respondents, Ethiopia, 2020.

Variables	Category	Frequency (n=615)	Percentage (100%)
Age	15 - 19 years	31	5
	20 – 24 years	523	85
	25 – 29 years	61	10
Residence	Urban	374	60.8
	Rural	241	39.2
Religion	Orthodox	422	68.6
	Muslim	77	12.5
	Protestant	102	16.6
	Others*	14	2.3
Marital status	Single	541	88.0
	Married	66	10.7
	Divorced & widowed	8	1.3
Fathers education	Unable to read and write	64	10.4
	Able to read and write	163	26.5
	1^{st} – 8^{th} grade	102	16.6
	9^{th} – 12^{th} grade	80	13.0
	College and above	206	33.5
Mothers education	Unable to read and write	142	23.1
	Able to read and write	146	23.7
	1^{st} – 8^{th} grade	104	16.9
	9^{th} – 12^{th} grade	96	15.6
	College and above	127	20.7
Family size	≤ 4	106	17.2
	5 – 8	450	73.2
	≥ 9	59	9.6
Average monthly stipends	≤ 150 ETB	31	5.0
	151 – 200 ETB	50	8.2
	201 – 300 ETB	72	11.7
	≥ 301 ETB	462	75.1

ETB- Ethiopian Birr Others*- Catholic, Adventist, Hawariyat

Psychosocial and contraception history

About one-fifth of respondents 114(18.5%) had previous attempts to lose weight, and 87(75.6%) of them performs an exercise to reduce weight. More than two-third (11.4%) of participants had used contraception. Of these, 36(51.4%) used Pills followed by 22(31.4%) injectable (Table 2).

Table 2: Psychosocial characteristics and contraception use of respondents, Ethiopia, 2020.

Characteristics	Category	Frequency (n=615)	Percent(100%)
History of attempts to lose weight	Yes	114	18.5
	No	501	81.5
Type of activities done to reduce weight (n=114)	Regular exercise	87	75.6
	Diet correction	18	15.1
	Both exercise and diet	6	5.9
	Other*	3	3.4
Exam/test/assignment related stress	Yes	315	51.2
	No	300	48.8
Disruption of social networks either family, friends or fiance	Yes	282	45.9
	No	333	54.1
Contraceptive use	Yes	70	11.4
	No	545	88.6
Type of contraception used	OCPs	36	51.4
	Injectable	22	31.4
	Implants	9	12.9
	IUCD	3	4.3
Duration of contraception use (n=70)	< 3 months	22	31.4
	3-6 months	14	20.0
	6-12 months	25	35.7
	> 1 years	9	12.9

Other*- Dancing, doing home works, drinking hot water and lemon

Lifestyle and behavioral characteristics

About three-forth (76.9%) of participants didn't involve in any physical activity. Three hundred forty-nine (56.7%) students drink one or two cups of coffee per day. More than two third (70%) of them do not consume alcohol at all. Nearly half (48.8%) of students drink Coca-Cola/Pepsi 2-3 times per week. About 378(61.5%) and 430(69.9%) of students get adequate sleep per night and eat breakfast more than five days per week, respectively (Table 3).

Table 3: Lifestyle and behavioral characteristics of participants, Ethiopia, 2020.

Characteristics	Category	Frequency (615)	Percent (100%)
Physical activity	Not at all	473	76.9
	< 5	115	18.7
	≥ 5	27	4.4
Cups of coffee taken per day	Not at all	244	39.7
	< 3	349	56.7
	≥ 3	22	3.6
Glasses of tea taken per day	Not at all	86	14.0
	< 4	506	82.3
	≥ 4	23	3.7
Teaspoons of sugar used per day	No at all	115	18.7
	Minimal	430	69.9
	Moderate	62	10.1
	Excessive	8	1.3
Alcohol consumption	Not at all	432	70.2
	2-3 times per month	167	27.2
	2-3 times per day	5	0.8
	I drink daily	11	1.8
Smoking	Not at all	598	97.2
	2-3X per month	11	1.8
	2-3 times per week	2	0.3
	Once per day	1	0.2
	More than one per day	3	0.5
Khat use	Not at all	595	96.7
	2-3X per month	13	2.1
	Once in a week	3	0.5
	2-3X per week	1	0.2
	On a daily basis	3	0.5
Coca-Cola/Pepsi use	Not at all	244	39.7
	2-3x per week	300	48.8
	Once per day	64	10.4
	More than one/day	7	1.1
Chocolate consumption	Not at all	352	57.2
	2-3 bars per week	214	34.8
	Two bars/day	29	4.7
	More than two bars/day	20	3.3
Sleeping hours	Inadequate (< 7 hrs)	237	38.5
	Adequate (≥ 7 hrs)	378	61.5
Breakfast per week	Not at all	20	3.3
	< 5	165	26.8
	≥ 5	430	69.9

Reproductive and menstrual characteristics

The mean age at menarche was 14.61±1.73 year ranging from 9-18 years. More than two-thirds 469(76.3%) of students experienced menarche in the age group of 13-16 years. Two-third 410(67%) of respondents had regular menstrual cycles, and 588(95.6%) of them had three to seven days of menstrual flow (Table 4).

Table 4: Reproductive and menstrual characteristics of respondents, Ethiopia, 2020.

Characteristics	Category	Frequency(n=615)	Percent(100%)
Age at menarche	≤ 12 years	67	10.9
	13 - 16 years	469	76.3
	≥ 17 years	79	12.8
Number of children	Not at all	593	96.4
	1	17	2.8
	≥ 2	5	0.8
Menstrual cycle pattern	Regular	410	66.7
	Irregular	205	33.3
Menstrual cycle length in days (n=410)	≤ 20 days	2	0.5
	21–35 days	405	98.8
	≥ 36 days	3	0.7
Duration of flow	≤ 2 days	22	3.6
	3-7 days	588	95.6
	≥ 8 days	5	0.8
Amount of menstrual blood	Light	41	6.7
	Moderate	559	90.9
	Heavy	15	2.4
Family history of dysmenorrhea	Yes	259	42.1
	No	356	57.9
Sexual intercourse	Yes	160	26.0
	No	455	74.0

Prevalence of dysmenorrhea

Nearly half 317(51.5%) of students had some degree of dysmenorrhea (Figure 1).

Associated factors of dysmenorrhea

There is 37% less risk of dysmenorrhea among students who skip breakfast (eat <5 days/week) compared to those who eat daily (AOR (95% CI) = 0.63(0.42-0.95)). However, the risk of dysmenorrhea was 2 times more prevalent among students whose father were unable to read and write (AOR (CI) =2.64(1.04-6.66)) and who had irregular menstrual cycles (AOR (CI) = 2.34(1.55-3.54)), and 3 times common among students who consume two bars of chocolate per day (AOR (CI= 3.39(1.28-8.93)), and who had family history of dysmenorrhea (AOR (CI) = 3.29(2.25-4.81)) (Table 5).

Table 5: Bivariable and multivariable analysis of associated factors of dysmenorrhea among HU students, Southern Ethiopia, 2020.

Variables	Categories	Dysmenorrhea		COR (95% CI)	AOR (95% CI)
		Yes (%)	No (%)		
Fathers education	Unable to read & write	31(48.4)	33(51.6)	0.94(0.54-1.65)	**2.64(1.04-6.66)***
	Able to read & write	75(46)	88(54)	0.85(0.57-1.29)	1.69(0.82-3.48)
	1st – 8th grade	59(57.8)	43(42.2)	1.37(0.85-2.21)	**2.08(1.02-4.26)***
	9th – 12th grade	49(61.2)	31(38.8)	1.58(0.93-2.68)	**2.64(1.35-5.15)****
	College and above	103(50)	103(50)	1	1
Attempt to lose weight	Yes	74(64.3)	41(35.7)	1.91(1.25-2.91)	1.52(0.90-2.56)
	No	243(48.6)	257(51.4)	1	1
Physical activity	Yes	82(57.7)	60(42.3)	1	1
	No	235(49.7)	238(50.3)	0.72(0.50-1.06)	0.91(0.57-1.45)
Coca-Cola /Pepsi use	Not at all	114(46.7)	130(53.3)	1	1
	2-3X per week	166(55.3)	134(44.7)	1.41(1.01-1.98)	1.33(0.89-2.00)
	≥ 1 per day	37(52.1)	34(47.9)	1.24(0.73-2.11)	1.19(0.61-2.35)
Chocolate consumption	Not at all	166(47.2)	186(52.8)	1	1
	2-3 bars per week	119(55.6)	95(44.4)	1.4(0.99-1.98)	1.31(0.86-2.00)
	Two bars/day	21(72.4)	8(27.6)	2.94(1.27-6.82)	**3.39(1.28-8.93)***
	> 2 bars/day	11(55)	9(45)	1.37(0.55-3.39)	2.17(0.68-6.91)
Stress	Yes	176(55.9)	139(44.1)	1.43(1.04-1.96)	1.13(0.78-1.64)
	No	141(47)	159(53)	1	1
Breakfast intake per week	Not at all	9(45)	11(55)	0.69(0.28-1.7)	0.74(0.25-2.17)
	< 5	75(45.5)	90(54.5)	0.71(0.49-1.01)	**0.63(0.42-0.95) ***
	≥ 5	233(54.2)	197(45.8)	1	1
Sleeping hours	< 7 hrs	112(47.3)	125(52.7)	0.76(0.55-1.05)	0.80(0.55-1.17)
	≥ 7 hrs	205(54.2)	173(45.8)	1	1
Menstrual cycle pattern	Regular	185(45.1)	225(54.9)	1	1
	Irregular	132(64.4)	73(35.6)	2.2(1.56-3.11)	**2.34(1.55-3.54)****
Amount of menstrual blood	Light	17(41.5)	24(58.5)	1	1
	Moderate	288(52.6)	260(47.4)	1.56(0.82-2.98)	1.37(0.67-2.88)
	Heavy	12(46.2)	14(53.8)	1.21(0.45-3.26)	0.66(0.20-2.12)
Family history	Yes	178(68.7)	81(31.3)	3.43(2.45-4.81)	**3.29(2.25-4.81)****
	No	139(39)	217(61)	1	1

* Statistically significant at P<0.05 ** Statistically significant at P<0.01

Academic performance

The mean cumulative grade point average (CGPA) of participants was 2.93 (SD ± 0.48). Two-third (66%) of students had the CGPA of ≥2.75 and 51.7% of students had above the mean CGPA. The mean CGPA of dysmenorrheic students was lower by 0.04 compared to non-dysmenorrheic students. However, the ANOVA test of association revealed that the mean CGPA of students has no statistically significant difference between groups (F (3,611) = 1.276, p = 0.28)). Therefore, there was no statistically significant difference in academic performance between students with and without dysmenorrhea.

Discussion

In this study, the prevalence of dysmenorrhea was 51.5%, 95% CI (47.6-55.1). The educational status of the father, family history of dysmenorrhea, chocolate consumption, daily breakfast intake, and irregular menses were associates of dysmenorrhea. Further, there was no statistically significant association between dysmenorrhea and academic performance.

The prevalence of dysmenorrhea in the present study was consistent with studies reported from Malaysia (51.5%) (29), and Georgia (52%) (6). However, it was lower than 66.8% in Debre Berhan, Ethiopia (21), 83.1% in Nigeria (30), 89% in Greece (13), 62.5% in India (31), 74.8% in Spain (32), and 87.7% in Turkey university students (33). The difference may account for lack of universally accepted, a standard definition of dysmenorrhea. They diagnosed merely based on a student's perception of pain, which is difficult to quantify and might be caused by non-menstrual events. In addition, it may be as a result of the socioeconomic and cultural differences in individuals' pain perception, and lifestyle factors.

Moreover, the study found a higher prevalence of dysmenorrhea than 45% among Indian young college students (34). This might be due to the differences in age variations and sample size. In an Indian study, the age group of students ranges from 18 to 21. However, in this study, the age group ranges from 18-29. The highest episode of dysmenorrhea occurs between the ages of 20-24 years (35). In addition, it included only 116 students from a single department and studied only primary dysmenorrhea. Such small samples might have suffered from participants without risk factors i.e. family history.

The result of this study confirmed a statistically significant association between the educational status of the father and dysmenorrhea. There is 2 times increased odds of developing dysmenorrhea among students whose fathers were unable to read and write with reference to those whose fathers were attended college and above. A similar result was obtained from Poland university students in which a decreased incidence of dysmenorrhea with paternal education was reported (36). This could be related to poor socioeconomic status and lower living standards, which in turn impose bad living conditions and lifestyles. Additionally, the studies used a similar design, setting, data collection techniques, and comparable age group of participants. Again, the same assessment tool (Andersch and Milsom scale) were used.

The study identified chocolate consumption as an important determinant factor for dysmenorrhea. The risk was three times more common among students who consume two bars of chocolate per day compared to those who do not consume at all. This was also represented in Debre Markos town in which dysmenorrhea was three times higher among students with excessive sugar intake (24). This might be explained by, the high sugar content compromises the absorption and metabolism of important vitamins and minerals, causing a muscle spasm, and which can be manifested by menstrual pain (22). In addition, it may be as a result of the precursors of prostaglandins, which are the cause of dysmenorrhea, might be found in sugar-containing meals (24).

It was found that skipping breakfast lowers the risk of dysmenorrhea by 37%. However, a study among university students of Palestine reported two times increased risk of dysmenorrhea among students who skip breakfast (37). In addition, a study from India established a significant risk of meal skipping, which increases the prevalence of dysmenorrhea two times (15). This might be due to socio-economic, cultural, religious and personal factors other than breakfast skipping that contributed to dysmenorrhea. This requires further research for clarification.

In this study, a statistically significant association between irregular menstrual cycles and dysmenorrhea was observed. A similar result was obtained in a study published from Ghana (38). Additionally, a study from Palestine indicated that students who have irregular menstrual cycles were approximately two times more likely to experience dysmenorrhea (37). This can be obviously due to the hyperproduction of prostaglandins by the endometrium, which results in increased uterine contractions and arterial vasoconstriction, causing ischemic pain.

Additionally, a positive family history of dysmenorrhea was found to be a strong determinant of the higher burden of dysmenorrhea. Similarly in Serbia, students with a family history were three times more likely to suffer from the problem (39). Again it was also reported from Debre Markos (24), Mekelle (9), Spain (32), and a systematic reviews conducted on both developing and developed countries (40). The possible explanation may be related to genetic factors and the risk of other hereditary causes such as endometriosis.

Finally, the association between dysmenorrhea and academic performance was examined. The mean CGPA of dysmenorrheic students was lower by 0.04 compared to non-dysmenorrheic students. However, there was no statistically significant difference in academic performance between students with and without dysmenorrhea. A comparable result was reported from Debre Berhan, Ethiopia (41). However, another study in Ethiopia established a statistically significant negative association (21). This inconsistent result might be due to the study measured only 6-month students' menstrual status despite the use of CGPA, which might be affected by previous semesters or years grade. In addition, it might be due to the differences in respondents' age and operationalization of dysmenorrhea.

Limitations

- The nature of cross-sectional study does not allow causal relationship.
- Self-administered data collection was applied that might add social desirability bias. To reduce the bias, anonymity and confidentiality was assured.
- The nature of self-perceived reporting may have resulted in recall bias and over/under-reporting of some variables.

Conclusion and recommendation

Dysmenorrhea was common among graduating University students. Educational status of the father, chocolate consumption, irregular menses, family history, and skipping breakfast had a statistically significant association with dysmenorrhea. No statistically significant difference in academic performance was observed among students with and without dysmenorrhea.

Better to promote the community to minimize the use of high sugar-containing meals, i.e. chocolate, to at least less than two bars per day and support students to have a regular follow up of their menstrual pattern and seek care in case of irregular periods. Further longitudinal studies are recommended to establish a causal relationship. Similar studies, with various study design and measurement, should be conducted in different settings for more representative findings, which will be helpful in designing interventional activities targeted at improving student's health and academic performance.

Abbreviations and acronym

AOR: Adjusted Odds Ratio
COR: Crude Odds Ratio
CI: Confidence Interval
GPA: Grade Point Average
HU: Hawassa University
MSS: Multidimensional Scoring System
OR: Odds Ratio
SRS: Simple Random Sampling
SPSS: Statistical Package for Social Sciences
WHO: World Health Organization

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Author's contribution

MT conceived and designed the proposal, performed analysis and prepared the final draft. GA followed the data collection process and provided basic comments. AK and AA approved the proposal, critically revised and made basic adjustments to the final paper. All authors read and approved the manuscript.

Competing interests

The authors declared no conflict of interests.

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Data sharing

Essential data used for conclusion are included in the manuscript. The original raw data analyzed is available from the corresponding author and can be presented upon reasonable request.

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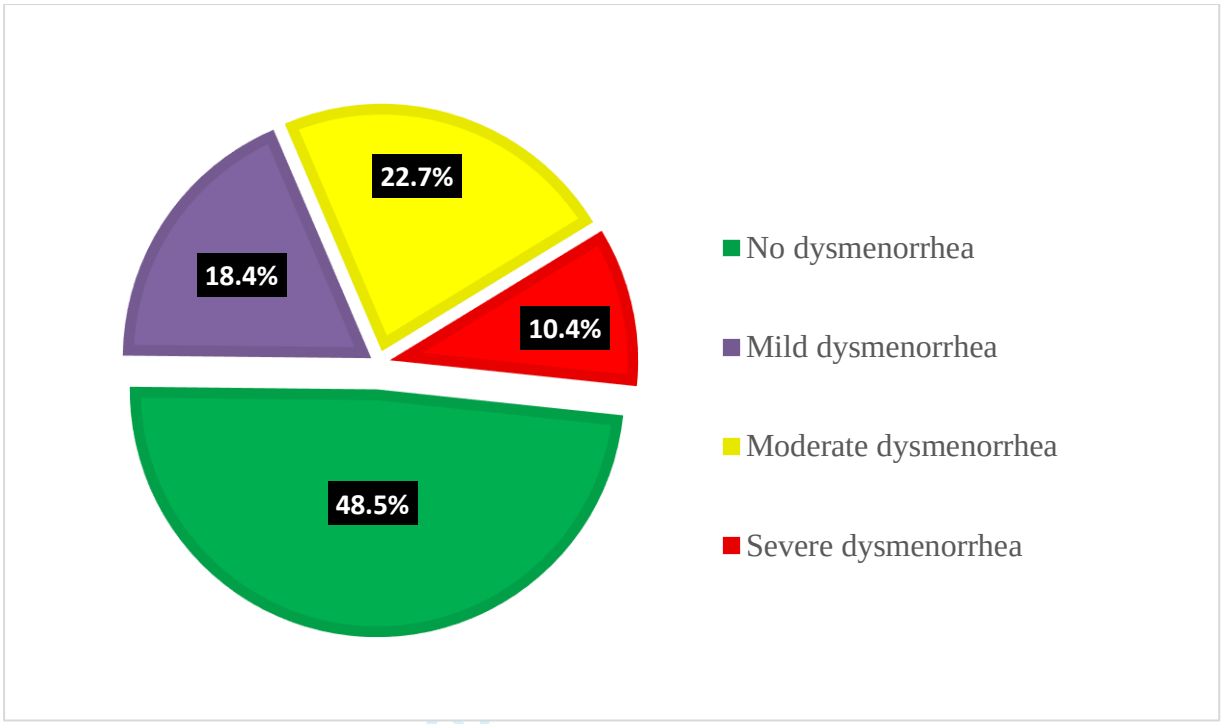

STROBE Statement—checklist of items that should be included in reports of ***cross-sectional studies***

	Item No.	Recommendation	Page No.
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 3
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5
Participants	6	Give the eligibility criteria, and the sources and methods of selection of participants	Page 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6
Bias	9	Describe any efforts to address potential sources of bias	Page 19
Study size	10	Explain how the study size was arrived at	Page 5

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 6
		(*b*) Describe any methods used to examine subgroups and interactions	Page 6
		(*c*) Explain how missing data were addressed	Page 8
		(d) If applicable, describe analytical methods taking account of sampling strategy	Page 5
		(*e*) Describe any sensitivity analyses	Page 6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 8
		(b) Give reasons for non-participation at each stage	Page 8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 8 and 9
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	Page 14 and 15
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 14 and 15
		(*b*) Report category boundaries when continuous variables were categorized	Page 15
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 20

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Prevalence of dysmenorrhea, associated risk factors, and its relationship with academic performance among graduating female university students in Ethiopia: A cross-sectional study

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Prevalence of dysmenorrhea, associated risk factors, and its relationship with academic performance among graduating female university students in Ethiopia: A cross-sectional study

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Abstract

Objectives: The study aimed to provide an association between dysmenorrhea and academic performance among university students in Ethiopia. Further, the study attempts to determine the prevalence and associated risk factors of dysmenorrhea.

Design and method: Institution based cross-sectional study was conducted from April 1 to 28, 2019. A semi-structured and pretested self-administered questionnaire was used to collect data. Binary logistic regression analysis and one-way analysis of variance (ANOVA) were performed to model dysmenorrhea and academic performance, respectively.

Setting and Participants: Ethiopia (2019: n = 647 female university students)

Outcomes: The primary outcome is dysmenorrhea, which has been defined as painful menses that prevents normal activity and requires medication. The self-reported cumulative grade point average (CGPA) of students was used as a proxy measure of academic performance, which is the secondary outcome.

Results: The prevalence of dysmenorrhea was 317(51.5%). The educational status of father (AOR (CI) =2.64(1.04-6.66)), chocolate consumption (AOR (CI= 3.39(1.28-8.93)), daily breakfast intake (< 5 days/week) (AOR (95% CI) = 0.63(0.42-0.95)), irregular menstrual cycle AOR (CI) = 2.34(1.55-3.54)) and positive family history of dysmenorrhea AOR (CI) = 3.29(2.25-4.81)) had statistically significant association with dysmenorrhea. There was no statistically significant difference in academic performance among students with and without dysmenorrhea (F (3,611) = 1.276, p = 0.28)).

Conclusions: Dysmenorrhea was a common health problem among graduating University students. However, it has no statistically significant impact on academic performance. Reproductive health officers should educate and undermine the negative academic consequences of dysmenorrhea to reduce the physical and psychological stress that happens to females and their families.

Strengths and limitations of this study

- The mean cumulative grade point average (CGPA) was used to measure the academic performance of students.
- A standardized Multidimensional Scoring System (MSS) was used to diagnose dysmenorrhea in Ethiopia.
- The nature of the cross-sectional study does not allow causal relationships.
- Self-administered data collection was applied that might add social desirability bias.
- The nature of self-perceived reporting may have resulted in recall bias and over/under-reporting of some variables.

Introduction

Dysmenorrhea also called painful periods or menstrual cramps is a recurrent, crampy pain that occurs during menstruation. It can be either primary without visible pelvic pathology, or secondary with an identifiable pelvic disorder (1, 2). The mechanisms of menstrual cramps are believed to be caused by hyper-production of uterine prostaglandins, particularly of prostaglandins F2α, which results in myometrial hyper-contractility and arterial vasoconstriction (2). Compared to non-dysmenorrheic women, those women with dysmenorrhea have higher levels of prostaglandins, especially within the first two days of menses (3). The uterine activity seen during the severe period is more intense than that seen in labor and results in intrauterine pressures well above tissue perfusion thresholds (4).

Dysmenorrhea is one of the most frequently happened gynecologic disorders among adolescent girls. Globally estimates of the burden of dysmenorrhea range from 50 to 95 percent (5, 6). This might be due to studies conducted among different age groups, the use of different definitions, and/or the absence of a standard method for measuring the severity of pain (7). The highest prevalence was reported from Egyptian university students, in which 93% of them had painful menstruation (5), and followed by 89.1% of Iran University students (8). In Ethiopia, a study among Mekelle University students stated the burden of dysmenorrhea was 71.8% (9).

Dysmenorrhea is responsible for substantial financial losses, that extends beyond the individual level to the future generations, due to the cost of medications, medical care, impaired daily activities, and decreased productivity (10). Among women affected by dysmenorrhea, about 15 to 20% of them were unable to perform their normal day to day activities during each menstrual period (2). For instance, in the US, around 140 million working hours are lost annually due to dysmenorrhea (11). Even those women who desire to work during their cramps have been shown to have lower work output. Besides, in Japan, an estimated $4.2 billion economic losses occur as a result of dysmenorrhea (12). Besides, it remains an important cause of recurrent short-term school and works absenteeism, and poor quality of life (13).

Dysmenorrhea not only affects the daily activity and socio-economic status but also associated with future risk of hyperemesis gravidarum (HG). A study from the State University of New York stated that women with a history of adolescent and adulthood dysmenorrhea were five times more

likely to develop HG. The risk increases by ten-fold for severe dysmenorrhea (14). This might be due to the assumption that prostaglandin and cytokine-induced, excessive nausea and vomiting seen in hyperemesis patients could be related to nausea and vomiting seen in severe dysmenorrhea. Thus, early diagnosis and treatment of severe nausea and vomiting in patients with a history of severe dysmenorrhea play a role in reducing the morbidity associated with HG (15).

Despite its common occurrence and significant impacts on day-to-day activities, many women fail to report pain and/or seek medical treatment, and hence, it is under-diagnosed and undertreated (7, 16). Only 14.2% of females seek medical care/advice, which indicates the importance of screening all adolescent girls for menstrual cramp (17).

Heedlessly, dysmenorrhea persists invisible and given low priority in most parts of the globe including Ethiopia compared to other health problems. So that, attention needs to be given to better prevention and management practices, and hence to improve the quality of life, productivity, and academic performance of the leaders of tomorrow, adolescent girls (7). Limited studies to date have been done to address the relationship between dysmenorrhea and academic performance in developing nations including Ethiopia. Hence, the study attempted to determine the prevalence, associated risk factors, and temporal association between dysmenorrhea and academic performance among university students in Ethiopia.

Research questions

1. What is the magnitude of dysmenorrhea?
2. What are the factors associated with dysmenorrhea?
3. Does dysmenorrhea have a statistically significant association with the academic performance of students?

Research hypothesis

- There is a statistically significant association between dysmenorrhea and the academic performance of students.

Methods

Study area and period

A cross-sectional study among female Hawassa University students was conducted from April 1 to 28, 2019 Gregorian calendar. Hawassa University is one of the oldest and well-established university in Ethiopia. During the study period (2019/20), the university had a total number of 21,579 students of which 7,955 were female. About 2118 female students were graduating class of 2019 Gregorian calendar. The university has one institute (Institute of Technology) and ten colleges. Totally, 8 colleges and 1 institute, organized with 75 departments had graduating class students.

Sample size determination

The required sample size was computed using Open Epi version 3.03 statistical software. The following assumptions were considered: proportion 66.8% (18), 95% confidence level, 5% level of significance, power 80%, margin of error, d = 5%, design effect, d = 2, and 10% non-response rate. By considering, the final sample size was 647.

Sampling technique and procedure

The study participants were selected from all-female graduating Hawassa University students using a multistage stratified sampling technique. First, the colleges were stratified into two: medical and non-medical. Then, four colleges were selected from non-medical colleges using simple random sampling (SRS) and the calculated sample size was distributed to each of the selected medical and non-medical colleges using probability proportional to size (PPS). In each of the selected colleges again departments were selected using SRS. Then, in the selected departments, the required sample size was proportionally allocated based on the number of total graduating students. Finally, from all graduating students of the selected departments, SRS was done to pick the required sample size using a pre-determined sampling frame of all departments where the samples were selected.

Inclusion and exclusion criteria

Female students who undergo their education in the selected departments and available at the time of data collection were included in the study. Students who were not regular and who were not willing to fill the questionnaire were excluded.

Data collection tool and procedure

Data was collected using a semi-structured self-administered questionnaire. The questionnaire was prepared concerning previous, similar published literature (9, 19-21). Then it was modified and contextualized to fit the local situation and the research objectives. The questionnaire was prepared in English and later translated to the local language, Amharic, and then back to English by different translators, to keep the consistency of the questionnaire.

Data quality control

A pre-test was conducted on 5% of the total sample (32 students) in Dilla University and necessary amendments were considered following the result of the pretest. Four BSc midwives facilitated the data collection. Two MPH students were recruited for supervising facilitators. The training was given for data collectors and supervisors for one day regarding the objectives, methodologies, data collection techniques, and ways to approach the participants. The supervisors were checking the day-to-day activities of data collectors regarding the completion of questionnaires, clarity of responses, and proper coding of the responses. There was continuous supervision to control the data collection procedure by the principal investigator.

Data management and analysis

The data were checked for clarity, completeness, and consistency. Epi-Data version 4.6 and SPSS version 20 were used for data entry and analysis, respectively. The descriptive statistics were presented using texts, frequency tables, graphs, mean, and percentages. Bivariable and multivariable logistic regression analysis was performed to identify independently associated factors of dysmenorrhea. One-way analysis of variance (ANOVA) test of association was applied to examine the mean difference in academic performance among students with and without dysmenorrhea. The strength of association was interpreted using adjusted odds ratios with a 95%

confidence interval and the Hosmer-Lemeshow goodness-of-fit was applied to test for model fitness. Statistically significant variables were declared at a p-value of ≤ 0.05.

Measurement

Dysmenorrhea: was considered if the girl had painful menstruation, unable to perform daily activities, and needs medical management or self-medication to control pain for the past 6 months (19, 22).

Academic performance: the self-reported cumulative grade point average (CGPA) of students were used as a proxy measure of academic performance (23).

The multi-dimensional Scoring system (MSS): is a scoring system that grades pain severity and took into account the impact of pain on daily activities, systemic symptoms, and analgesic requirements (24).

Grade 0 (No dysmenorrhea): menstruation is not painful and daily activities are not affected.

Grade 1 (Mild): menstruation is painful but seldom inhibits normal activity. Pain killers are rarely required.

Grade 2 (Moderate): painful period and affects daily activities. Pain killers are required; however, they give sufficient relief so that absence from class is unusual.

Grade 3 (Severe): is a painful menses that severely limit normal daily activities and results in noticeable symptoms (such as headache, fatigue, vomiting, and diarrhea) and refractory to analgesics.

Patient and public involvement

There was no patient and public involvement in the design and planning of this study.

Ethical consideration

Ethical approval was obtained from the institutional review board of Hawassa University, college of medicine, and health science (Ref. No: IRB/210/11). Verbal informed consent was obtained from the study participants. Data was kept confidential and anonymous and were used only for research purposes.

Result

A total of 615 female students participated in the study, making a response rate of 95.1%. Thirteen (2.0%) respondents had a lack of interest and shortage of time, and the rest 19(2.9%) questionnaires were found to be incomplete and excluded from the analysis.

Socio-demographic characteristics of participants

The age of the participants ranged from 18-29 years with the mean age of 21.68±2 (SD) years and more than half 380(61.8%) of the respondents were found in the age range of 21 - 25 years. Most of the respondents 422(68.6%) were followers of Orthodox Christianity and three-fourth, 462(75.1%) of students earn more than 301 Ethiopian birrs per month (Table 1).

Table 1: Sociodemographic characteristics of the respondents.

Variables	Category	Frequency (n=615)	Percent (%)
Age	15 - 19 years	31	5.0
	20 – 24 years	523	85.0
	25 – 29 years	61	10.0
Residence	Urban	374	60.8
	Rural	241	39.2
Religion	Orthodox	422	68.6
	Muslim	77	12.5
	Protestant	102	16.6
	Others*	14	2.3
Marital status	Single	541	88.0
	Married	66	10.7
	Divorced & widowed	8	1.3
Fathers education	Unable to read and write	64	10.4
	Able to read and write	163	26.5
	1^{st} – 8^{th} grade	102	16.6
	9^{th} – 12^{th} grade	80	13.0
	College and above	206	33.5
Mothers education	Unable to read and write	142	23.1
	Able to read and write	146	23.7
	1^{st} – 8^{th} grade	104	16.9
	9^{th} – 12^{th} grade	96	15.6
	College and above	127	20.7
Family size	≤ 4	106	17.2
	5 – 8	450	73.2
	≥ 9	59	9.6
Average monthly stipends	≤ 150 ETB	31	5.0
	151 – 200 ETB	50	8.2
	201 – 300 ETB	72	11.7
	≥ 301 ETB	462	75.1

ETB- Ethiopian Birr Others*- Catholic, Adventist, Hawariyat

Psychosocial and contraception history

About one-fifth of respondents 114(18.5%) had previous attempts to lose weight, and 87(75.6%) of them performs an exercise to reduce weight. More than two-thirds (11.4%) of participants had used contraception. Of these, 36(51.4%) used Pills followed by 22(31.4%) injectable (Table 2).

Table 2: Psychosocial characteristics and contraception use of respondents.

Characteristics	Category	Frequency (n=615)	Percent (%)
History of attempts to lose weight	Yes	114	18.5
	No	501	81.5
Type of activities done to reduce weight (n=114)	Regular exercise	87	75.6
	Diet correction	18	15.1
	Both exercise and diet	6	5.9
	Other*	3	3.4
Exam/test/assignment related stress	Yes	315	51.2
	No	300	48.8
Disruption of social networks either family, friends or fiance	Yes	282	45.9
	No	333	54.1
Contraceptive use	Yes	70	11.4
	No	545	88.6
Type of contraception used	OCPs	36	51.4
	Injectable	22	31.4
	Implants	9	12.9
	IUCD	3	4.3
Duration of contraception use (n=70)	< 3 months	22	31.4
	3-6 months	14	20.0
	6-12 months	25	35.7
	> 1 years	9	12.9

Other*- Dancing, doing home works, drinking hot water and lemon

Lifestyle and behavioral characteristics

About three-forth (76.9%) of participants did not involve in any physical activity. Three hundred forty-nine (56.7%) students drink one or two cups of coffee per day. More than two-thirds (70%) of them do not consume alcohol at all. Nearly half (48.8%) of students drink Coca-Cola/Pepsi 2-3 times per week. About 378(61.5%) and 430(69.9%) of students get adequate sleep per night and eat breakfast more than five days per week, respectively (Table 3).

Table 3: Lifestyle and behavioral characteristics of participants.

Characteristics	Category	Frequency (615)	Percent (%)
Physical activity	Not at all	473	76.9
	< 5	115	18.7
	≥ 5	27	4.4
Cups of coffee taken per day	Not at all	244	39.7
	< 3	349	56.7
	≥ 3	22	3.6
Glasses of tea taken per day	Not at all	86	14.0
	< 4	506	82.3
	≥ 4	23	3.7
Teaspoons of sugar used per day	No at all	115	18.7
	Minimal	430	69.9
	Moderate	62	10.1
	Excessive	8	1.3
Alcohol consumption	Not at all	432	70.2
	2-3 times per month	167	27.2
	2-3 times per day	5	0.8
	I drink daily	11	1.8
Smoking	Not at all	598	97.2
	2-3X per month	11	1.8
	2-3 times per week	2	0.3
	Once per day	1	0.2
	More than one per day	3	0.5
Khat use	Not at all	595	96.7
	2-3X per month	13	2.1
	Once a week	3	0.5
	2-3X per week	1	0.2
	Daily	3	0.5
Coca-Cola/Pepsi use	Not at all	244	39.7
	2-3x per week	300	48.8
	Once per day	64	10.4
	More than one/day	7	1.1
Chocolate consumption	Not at all	352	57.2
	2-3 bars per week	214	34.8
	Two bars/day	29	4.7
	More than two bars/day	20	3.3
Sleeping hours	Inadequate (< 7 hrs.)	237	38.5
	Adequate (≥ 7 hrs.)	378	61.5
Breakfast per week	Not at all	20	3.3
	< 5	165	26.8
	≥ 5	430	69.9

Reproductive and menstrual characteristics

The mean age at menarche was 14.61±1.73 years ranging from 9-18 years. More than two-thirds of 469(76.3%) of students experienced menarche in the age group of 13-16 years. Two-third 410(67%) of respondents had regular menstrual cycles, and 588(95.6%) of them had three to seven days of menstrual flow (Table 4).

Table 4: Reproductive and menstrual characteristics of respondents.

Characteristics	Category	Frequency(n=615)	Percent (100%)
Age at menarche	≤ 12 years	67	10.9
	13 - 16 years	469	76.3
	≥ 17 years	79	12.8
Number of children	Not at all	593	96.4
	1	17	2.8
	≥ 2	5	0.8
Menstrual cycle pattern	Regular	410	66.7
	Irregular	205	33.3
Menstrual cycle length in days (n=410)	≤ 20 days	2	0.5
	21–35 days	405	98.8
	≥ 36 days	3	0.7
Duration of flow	≤ 2 days	22	3.6
	3-7 days	588	95.6
	≥ 8 days	5	0.8
Amount of menstrual blood	Light	41	6.7
	Moderate	559	90.9
	Heavy	15	2.4
Family history of dysmenorrhea	Yes	259	42.1
	No	356	57.9
Sexual intercourse	Yes	160	26.0
	No	455	74.0

Prevalence of dysmenorrhea

Nearly half of 317(51.5%) students had some degree of dysmenorrhea.

Associated factors of dysmenorrhea

There is 37% less risk of dysmenorrhea among students who skip breakfast (eat <5 days/week) compared to those who eat daily (AOR (95% CI) = 0.63(0.42-0.95)). However, the risk of dysmenorrhea was 2 times more prevalent among students whose father were unable to read and write (AOR (CI) =2.64(1.04-6.66)) and who had irregular menstrual cycles (AOR (CI) = 2.34(1.55-3.54)), and 3 times common among students who consume two bars of chocolate per day (AOR (CI= 3.39(1.28-8.93)), and who had a family history of dysmenorrhea (AOR (CI) = 3.29(2.25-4.81)) (Table 5).

Table 5: Bivariable and multivariable analysis of associated factors of dysmenorrhea.

Variables	Categories	Dysmenorrhea		COR (95% CI)	AOR (95% CI)
		Yes (%)	No (%)		
Fathers education	Unable to read & write	31(48.4)	33(51.6)	0.94(0.54-1.65)	**2.64(1.04-6.66)***
	Able to read & write	75(46)	88(54)	0.85(0.57-1.29)	1.69(0.82-3.48)
	1st – 8th grade	59(57.8)	43(42.2)	1.37(0.85-2.21)	**2.08(1.02-4.26)***
	9th – 12th grade	49(61.2)	31(38.8)	1.58(0.93-2.68)	**2.64(1.35-5.15)****
	College and above	103(50)	103(50)	1	1
Attempt to lose weight	Yes	74(64.3)	41(35.7)	1.91(1.25-2.91)	1.52(0.90-2.56)
	No	243(48.6)	257(51.4)	1	1
Physical activity	Yes	82(57.7)	60(42.3)	1	1
	No	235(49.7)	238(50.3)	0.72(0.50-1.06)	0.91(0.57-1.45)
Coca-Cola /Pepsi use	Not at all	114(46.7)	130(53.3)	1	1
	2-3X per week	166(55.3)	134(44.7)	1.41(1.01-1.98)	1.33(0.89-2.00)
	≥ 1 per day	37(52.1)	34(47.9)	1.24(0.73-2.11)	1.19(0.61-2.35)
Chocolate consumption	Not at all	166(47.2)	186(52.8)	1	1
	2-3 bars per week	119(55.6)	95(44.4)	1.4(0.99-1.98)	1.31(0.86-2.00)
	Two bars/day	21(72.4)	8(27.6)	2.94(1.27-6.82)	**3.39(1.28-8.93)***
	> 2 bars/day	11(55)	9(45)	1.37(0.55-3.39)	2.17(0.68-6.91)
Stress	Yes	176(55.9)	139(44.1)	1.43(1.04-1.96)	1.13(0.78-1.64)
	No	141(47)	159(53)	1	1
Breakfast intake per week	Not at all	9(45)	11(55)	0.69(0.28-1.7)	0.74(0.25-2.17)
	< 5	75(45.5)	90(54.5)	0.71(0.49-1.01)	**0.63(0.42-0.95) ***
	≥ 5	233(54.2)	197(45.8)	1	1
Sleeping hours	< 7 hrs.	112(47.3)	125(52.7)	0.76(0.55-1.05)	0.80(0.55-1.17)
	≥ 7 hrs.	205(54.2)	173(45.8)	1	1
Menstrual cycle pattern	Regular	185(45.1)	225(54.9)	1	1
	Irregular	132(64.4)	73(35.6)	2.2(1.56-3.11)	**2.34(1.55-3.54)****
Amount of menstrual blood	Light	17(41.5)	24(58.5)	1	1
	Moderate	288(52.6)	260(47.4)	1.56(0.82-2.98)	1.37(0.67-2.88)
	Heavy	12(46.2)	14(53.8)	1.21(0.45-3.26)	0.66(0.20-2.12)
Family history	Yes	178(68.7)	81(31.3)	3.43(2.45-4.81)	**3.29(2.25-4.81)****
	No	139(39)	217(61)	1	1

* Statistically significant at P<0.05 ** Statistically significant at P<0.01

Academic performance

The mean cumulative grade point average (CGPA) of participants was 2.93 (SD ± 0.48). Two-third (66%) of students had a CGPA of ≥2.75 and 51.7% of students had above the mean CGPA. The mean CGPA of dysmenorrheic students was lower by 0.04 compared to non-dysmenorrheic students. However, the ANOVA test of association revealed that the mean CGPA of students has no statistically significant difference between groups (F (3,611) = 1.276, p = 0.28)). Therefore, there was no statistically significant difference in academic performance between students with and without dysmenorrhea (Table 6).

Table 6: ANOVA test of association

ANOVA

CGPA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.878	3	.293	1.276	.282
Within Groups	140.064	611	.229		
Total	140.941	614			

Discussion

In this study, the prevalence of dysmenorrhea was 51.5%, 95% CI (47.6-55.1). The educational status of the father, family history of dysmenorrhea, chocolate consumption, daily breakfast intake, and irregular menses were associates of dysmenorrhea. Further, there was no statistically significant association between dysmenorrhea and academic performance.

The prevalence of dysmenorrhea in the present study was consistent with studies reported from Malaysia (51.5%) (25), and Georgia (52%) (6). However, it was lower than 66.8% in Debre Berhan, Ethiopia (18), 89% in Greece (26), 62.5% in India (27), 74.8% in Spain (28), and 87.7% in Turkey university students (29). The difference may account for the lack of a universally accepted, standard definition of dysmenorrhea. They are diagnosed merely based on a student's perception of pain, which is difficult to quantify and might be caused by non-menstrual events. Besides, it may be a result of the socioeconomic and cultural differences in individuals' pain perception, and lifestyle factors.

Moreover, the study found a higher prevalence of dysmenorrhea than 45% among Indian young college students (30). This might be due to the differences in age variations and sample size. In an Indian study, the age group of students ranges from 18 to 21. However, in this study, the age group ranges from 18-29. The highest episode of dysmenorrhea occurs between the ages of 20-24 years (31). Besides, it included only 116 students from a single department and studied only primary dysmenorrhea. Such small samples might have suffered from participants without risk factors i.e. family history.

The result of this study confirmed a statistically significant association between the educational status of the father and dysmenorrhea. There is 2 times increased odds of developing dysmenorrhea among students whose fathers were unable to read and write with reference to those whose fathers have attended college and above. A similar result was obtained from Poland university students in which a decreased incidence of dysmenorrhea with paternal education was reported (32). This could be related to poor socioeconomic status and lower living standards, which in turn impose bad living conditions and lifestyles. Additionally, the studies used a similar design, setting, data collection techniques, and comparable age group of participants. Again, the same assessment tool (Andersch and Milsom scale) was used.

The study identified chocolate consumption as an important determinant factor for dysmenorrhea. The risk was three times more common among students who consume two bars of chocolate per day compared to those who do not consume at all. Similarly, a systematic review of observational studies stated that excessive sugar intake creates pain in the menstrual cycle (33). This was also represented in Debre Markos town in which dysmenorrhea was three times higher among students with excessive sugar intake (21). This might be explained by, the high sugar content compromises the absorption and metabolism of important vitamins and minerals, causing a muscle spasm, which can be manifested by menstrual pain (19). Besides, it may be a result of the precursors of prostaglandins, which are the cause of dysmenorrhea, which might be found in sugar-containing meals (21).

It was found that skipping breakfast lowers the risk of dysmenorrhea by 37%. This might be due to socio-economic, cultural, religious, and personal factors other than breakfast skipping that contributed to dysmenorrhea. However, a study among university students of Palestine reported two times increased risk of dysmenorrhea among students who skip breakfast (34). This could be due to the study assessed those who never/sometimes eat breakfast. But, in this study, we assessed those who sometimes skips breakfast (≤4 days per week). Hence, never/sometimes eating breakfast might have resulted in poor nutrient absorption that may lead to irregular menses and increased pain intensity (35). In another way, in Spain, breakfast skipping has no significant association with both menstrual pain and intensity of the pain (36). This requires further research for clarification.

In this study, a statistically significant association between irregular menstrual cycles and dysmenorrhea was observed. A similar result was obtained in a study published in Ghana (37). Additionally, a study from Palestine indicated that students who have irregular menstrual cycles were approximately two times more likely to experience dysmenorrhea (34). This can be obviously due to the hyperproduction of prostaglandins by the endometrium, which results in increased uterine contractions and arterial vasoconstriction, causing ischemic pain.

Additionally, a positive family history of dysmenorrhea was found to be a strong determinant of the higher burden of dysmenorrhea. Similarly in Serbia, students with a family history were three times more likely to suffer from the problem (38). Again it was also reported from Debre Markos (21), Mekelle (9), Spain (28), and systematic reviews conducted on both developing and developed

countries (39). The possible explanation may be related to genetic factors and the risk of other hereditary causes such as endometriosis.

Finally, the association between dysmenorrhea and academic performance was examined. The mean CGPA of dysmenorrheic students was lower by 0.04 compared to non-dysmenorrheic students. However, there was no statistically significant difference in academic performance between students with and without dysmenorrhea. A comparable result was reported from Debre Berhan, Ethiopia (40). Similarly, a study in Spain reported that dysmenorrhea does not correlate with the quality of life of university students (13). However, a systematic review and meta-analysis in low- and middle-income countries concluded that dysmenorrhea has a statistically significant negative influence on academic performance both at school and during higher education (41). Besides, dysmenorrhea was observed to cause absenteeism, and hence a negative impact on academic performance (42, 43). Further, another study in Ethiopia established a statistically significant negative association (18). This inconsistent result might be due to the study measured only 6-month students' menstrual status despite the use of CGPA, which might be affected by previous semesters or years grade. Besides, it might be due to the differences in respondents' age and operationalization of dysmenorrhea. The prevalence of dysmenorrhea decreases after 25 years of age (31), where the age in the systematic review and meta-analysis study ranges from 13 to 23 years, but in this study, it was 18 to 29 years. The decreasing burden of the problem may result in non-significant consequences. Further, the above studies measured academic performance with respect to class absenteeism, class concentration, and lack of focus on exam. However, this study used CGPA as a proxy measure of academic performance, which could be greatly responsible for the disparity.

Limitations

- The nature of the cross-sectional study does not allow causal relationships.
- Self-administered data collection was applied that might add social desirability bias. To reduce bias, anonymity, and confidentiality was assured.
- The nature of self-perceived reporting may have resulted in recall bias and over/under-reporting of some variables.

Conclusion and recommendation

Dysmenorrhea was a common health problem among graduating University students. The educational status of the father, chocolate consumption, irregular menses, family history, and skipping breakfast had a statistically significant association with dysmenorrhea. Dysmenorrhea has no statistically significant impact on the academic performance of university students.

Reproductive health officers should educate and sensitize the community to minimize the use of high sugar-containing snacks, i.e. chocolate, and support students to have a regular follow up of their menstrual pattern and seek care in case of irregular periods. Further longitudinal studies are recommended to establish a causal relationship. Similar studies, with various study design and measurement, should be conducted in different settings for more representative findings, which will help design interventional activities targeted at improving student's health and academic performance.

Abbreviations and acronym

AOR: Adjusted Odds Ratio

COR: Crude Odds Ratio

CI: Confidence Interval

CGPA: Cumulative Grade Point Average

MSS: Multidimensional Scoring System

OR: Odds Ratio

SRS: Simple Random Sampling

SPSS: Statistical Package for Social Sciences

WHO: World Health Organization

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Author's contribution

MT conceived and designed the proposal, performed analysis, and prepared the final draft. GA followed the data collection process and provided basic comments. AK and AA approved the proposal, critically revised, and made basic adjustments to the final paper. All authors read and approved the manuscript.

Competing interests

The authors declared no conflict of interest.

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Data sharing

Essential data used for the conclusion are included in the manuscript. The original raw data analyzed is available from the corresponding author and can be presented upon a reasonable request.

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Annex I: Questionnaire used to collect the data

Part I: Socio-demographic characteristics

S. No	Questions	Response & Coding Categories	Skip
101	How old are you?	_____ Years	
102	Where did you come from?	1. Rural 2. Urban	
103	What is your religion?	1. Orthodox 2. Muslim 3. Protestant 4. Other, Specify _____	
104	What is your current marital status?	1. Single 2. Married 3. Divorced 4. Widowed	
105	What is your cumulative GPA?	_____	
106	What is your family size?	_____	
107	What is your father's educational status?	1. Unable to read and write 2. Able to read and write 3. Elementary 4. Secondary 5. College and above	
108	What is your mother's educational status?	1. Unable to read and write 2. Able to read and write 3. Elementary 4. Secondary 5. College and above	
109	What is your average monthly stipends?	_____ Birr	

Part II: Psychosocial and contraception history

S. No	Questions	Response & Coding Categories	Skip
201	Do you have a history of attempts to lose weight?	1.Yes 2. No	If no, skip to 203
202	If yes to question number 201 what activities did you perform?	_____	
203	Do you experience stress/tension during exams, tests, and or assignments?	1. Yes 2. No	
204	Disruption of social networks like with family, friends, or people you love in the past one year?	1. Yes 2. No	
205	Have you ever used contraceptive in the last 3 months?	1. Yes 2. No	If no skip Q206 & Q207
206	If yes to question number 205, which type?	1. OCPs 2. Injectable 3. Implant 4. IUCD 5. Others, specify_____	
207	For how long you used it?	_____	

Part III: Lifestyle and behavioral characteristics

S. No	Questions	Response & Coding Categories	Skip
301	Have you been engaged in physical activity?	Yes No	If no skip to Q303
302	If yes to Q301, how many days do you perform per week?	_____ days	
303	How many cups of coffee do you take in a day?	_____	

304	How many glasses of tea do you take in a day?	_____	
305	How often do you take alcohol like Tej, Tella, Areke, and Beer?	1. Not at all 2. 2-3 times in a month 3. 2-3 times in a day 4. Daily	
306	Do you smoke a cigarette?	1. Not at all 2. 2-3 times per month 3. 2-3 times per week 4. Once per day 5. More than once per day	
307	Do you use Khat?	1. Not at all 2. 2 -3 times per month 3. Once a week 4. 2 to 3 times per week 5. Daily	
308	How many teaspoons of sugar do you take in a day?	_____	
309	Do you use Coca-Cola or Pepsi?	1. Not at all 2. 2-3 times per week 3. Once per day 4. More than one per day	
310	Do you consume Chocolate?	1. Not at all 2. 2-3 bars per week 3. Two bars per day 4. More than two bars per day	
311	How many hours do you sleep per day (only at night)?	_____ hours	
312	How many days do you eat your breakfast per week?	_____ days	

Part IV: Reproductive and menstruation-related issues

S. No	Questions	Response & Coding Categories	Skip
401	What was your age at menarche?	_____	
402	Have you ever been pregnant?	Yes No	If no skip to 404
403	If yes, how many times you became pregnant?	_____	
404	Is your period regular?	1. Yes 2. No	If yes skip to Q406
405	If no to Q404, have you ever used medications?		
406	How frequent is your period? (in days)	_____	
407	For how many days your period flow?	_____	
408	How many pads did you change in a day during your period?	_____	
409	Do you have a family history of dysmenorrhea?	1. Yes 2. No	If no skip to Q411
410	If yes to Q409, which family member? (you can select more than one option).	1. Sister 2. Mother 3. Grandmother 4. Other specify_____	
411	Have you ever had sexual intercourse?	1. Yes 2. No	

Part V: Multidimensional scoring system

S. No	Questions	Responses
501	Is your menstruation not painful and daily activity is not affected in the past 6 months?	1. Yes 2. No
	#If yes, leave the other questions	
502	Is your menstruation painful but seldom inhibits normal activity; analgesics are seldom required in the past 6 months?	1. Yes 2. No
	#If yes, leave the other questions	
503	Is your daily activity affected; analgesics required and give sufficient relief so that absence from school is unusual in the past 6 months?	1. Yes 2. No
	#If yes, leave the next question	
504	Is your activity clearly inhibited; poor effect of analgesics; and vegetative symptoms (headache, fatigue, vomiting, and diarrhea) present in the past 6 months?	1. Yes 2. No

Thank you for your cooperation!!!

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Prevalence of dysmenorrhea, associated risk factors, and its relationship with academic performance among graduating female university students in Ethiopia: A cross-sectional study

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Prevalence of dysmenorrhea, associated risk factors, and its relationship with academic performance among graduating female university students in Ethiopia: A cross-sectional study

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Abstract

Objectives: The study aimed to provide an association between dysmenorrhea and academic performance among university students in Ethiopia. Further, the study attempts to determine the prevalence and associated risk factors of dysmenorrhea.

Design and method: Institution based cross-sectional study was conducted from April 1 to 28, 2019. A semi-structured and pretested self-administered questionnaire was used to collect data. Binary logistic regression analysis and one-way analysis of variance (ANOVA) were performed to model dysmenorrhea and academic performance, respectively.

Setting and Participants: Ethiopia (2019: n = 647 female university students)

Outcomes: The primary outcome is dysmenorrhea, which has been defined as painful menses that prevents normal activity and requires medication. The self-reported cumulative grade point average (CGPA) of students was used as a proxy measure of academic performance, which is the secondary outcome.

Results: The prevalence of dysmenorrhea was 317(51.5%). The educational status of father (AOR (CI) =2.64(1.04-6.66)), chocolate consumption (AOR (CI= 3.39(1.28-8.93)), daily breakfast intake (< 5 days/week) (AOR (95% CI) = 0.63(0.42-0.95)), irregular menstrual cycle AOR (CI) = 2.34(1.55-3.54)) and positive family history of dysmenorrhea AOR (CI) = 3.29(2.25-4.81)) had statistically significant association with dysmenorrhea. There was no statistically significant difference in academic performance among students with and without dysmenorrhea (F (3,611) = 1.276, p = 0.28)).

Conclusions: Dysmenorrhea was a common health problem among graduating University students. However, it has no statistically significant impact on academic performance. Reproductive health officers should educate and undermine the negative academic consequences of dysmenorrhea to reduce the physical and psychological stress that happens to females and their families.

Strengths and limitations of this study

- The mean cumulative grade point average (CGPA) was used to measure the academic performance of students.
- A standardized Multidimensional Scoring System (MSS) was used to diagnose dysmenorrhea in Ethiopia.
- The nature of the cross-sectional study does not allow causal relationships.
- Self-administered data collection was applied that might add social desirability bias.
- The nature of self-perceived reporting may have resulted in recall bias and over/under-reporting of some variables.

Introduction

Dysmenorrhea also called painful periods or menstrual cramps is a recurrent, crampy pain that occurs during menstruation. It can be either primary without visible pelvic pathology, or secondary with an identifiable pelvic disorder (1, 2). The mechanisms of menstrual cramps are believed to be caused by hyper-production of uterine prostaglandins, particularly of prostaglandins F2α, which results in myometrial hyper-contractility and arterial vasoconstriction (2). Compared to non-dysmenorrheic women, those women with dysmenorrhea have higher levels of prostaglandins, especially within the first two days of menses (3). The uterine activity seen during the severe period is more intense than that seen in labor and results in intrauterine pressures well above tissue perfusion thresholds (4).

Dysmenorrhea is one of the most frequently happened gynecologic disorders among adolescent girls. Globally estimates of the burden of dysmenorrhea range from 50 to 95 percent (5, 6). This might be due to studies conducted among different age groups, the use of different definitions, and/or the absence of a standard method for measuring the severity of pain (7). The highest prevalence was reported from Egyptian university students, in which 93% of them had painful menstruation (5), and followed by 89.1% of Iran University students (8). In Ethiopia, a study among Mekelle University students stated the burden of dysmenorrhea was 71.8% (9).

Dysmenorrhea is responsible for substantial financial losses, that extends beyond the individual level to the future generations, due to the cost of medications, medical care, impaired daily activities, and decreased productivity (10). Among women affected by dysmenorrhea, about 15 to 20% of them were unable to perform their normal day to day activities during each menstrual period (2). For instance, in the US, around 140 million working hours are lost annually due to dysmenorrhea (11). Even those women who desire to work during their cramps have been shown to have lower work output. Besides, in Japan, an estimated $4.2 billion economic losses occur as a result of dysmenorrhea (12). Besides, it remains an important cause of recurrent short-term school and works absenteeism, and poor quality of life (13).

Dysmenorrhea not only affects the daily activity and socio-economic status but also associated with the future risk of hyperemesis gravidarum (HG). A study from the State University of New York stated that women with a history of adolescent and adulthood dysmenorrhea were five times

more likely to develop HG. The risk increases by ten-fold for severe dysmenorrhea (14). This might be due to the assumption that prostaglandin and cytokine-induced, excessive nausea and vomiting seen in hyperemesis patients could be related to nausea and vomiting seen in severe dysmenorrhea. Thus, early diagnosis and treatment of severe nausea and vomiting in patients with a history of severe dysmenorrhea play a role in reducing the morbidity associated with HG (15).

Despite its common occurrence and significant impacts on day-to-day activities, many women fail to report pain and/or seek medical treatment, and hence, it is under-diagnosed and undertreated (7, 16). Only 14.2% of females seek medical care/advice, which indicates the importance of screening all adolescent girls for menstrual cramps (17).

Heedlessly, dysmenorrhea persists invisible and is given low priority in most parts of the globe including Ethiopia compared to other health problems. So that, attention needs to be given to better prevention and management practices, and hence to improve the quality of life, productivity, and academic performance of the leaders of tomorrow, adolescent girls (7). Limited studies to date have been done to address the relationship between dysmenorrhea and academic performance in developing nations including Ethiopia. Hence, the study attempted to determine the prevalence, associated risk factors, and temporal association between dysmenorrhea and academic performance among university students in Ethiopia.

Research questions

1. What is the magnitude of dysmenorrhea?
2. What are the factors associated with dysmenorrhea?
3. Does dysmenorrhea have a statistically significant association with the academic performance of students?

Research hypothesis

- There is a statistically significant association between dysmenorrhea and the academic performance of students.

Methods

Study area and period

A cross-sectional study among female Hawassa University students was conducted from April 1 to 28, 2019 Gregorian calendar. Hawassa University is one of the oldest and well-established university in Ethiopia. During the study period (2019/20), the university had a total number of 21,579 students of which 7,955 were female. About 2118 female students were graduating class of 2019 Gregorian calendar. The university has one institute (Institute of Technology) and ten colleges. Totally, 8 colleges and 1 institute, organized with 75 departments had graduating class students.

Sample size determination

The required sample size was computed using Open Epi version 3.03 statistical software. The following assumptions were considered: proportion 66.8% (18), 95% confidence level, 5% level of significance, power 80%, margin of error, d = 5%, design effect, d = 2, and 10% non-response rate. By considering, the final sample size was 647.

Sampling technique and procedure

The study participants were selected from all-female graduating Hawassa University students using a multistage stratified sampling technique. First, the colleges were stratified into two: medical and non-medical. Then, four colleges were selected from non-medical colleges using simple random sampling (SRS) and the calculated sample size was distributed to each of the selected medical and non-medical colleges using probability proportional to size (PPS). In each of the selected colleges again departments were selected using SRS. Then, in the selected departments, the required sample size was proportionally allocated based on the number of total graduating students. Finally, for all graduating students of the selected departments, SRS was done to pick the required sample size using a pre-determined sampling frame of all departments where the samples were selected.

Inclusion and exclusion criteria

Female students enrolled in the academic year of 2019/2020 aged between 18-29 years, and who undergo their education in the selected departments and available at the time of data collection

were included in the study. Students who were not regular, not mentally and physically competent, and who were not willing to fill the questionnaire were excluded.

Data collection tool and procedure

Data was collected using a semi-structured self-administered questionnaire. The questionnaire was prepared concerning previous, similar published literature (9, 19-21). Then it was modified and contextualized to fit the local situation and the research objectives. The questionnaire was prepared in English and later translated to the local language, Amharic, and then back to English by different translators, to keep the consistency of the questionnaire.

Data quality control

A pre-test was conducted on 5% of the total sample (32 students) in Dilla University and necessary amendments were considered following the result of the pretest. Four BSc midwives facilitated the data collection. Two MPH students were recruited for supervising facilitators. The training was given to data collectors and supervisors for one day regarding the objectives, methodologies, data collection techniques, and ways to approach the participants. The supervisors were checking the day-to-day activities of data collectors regarding the completion of questionnaires, clarity of responses, and proper coding of the responses. There was continuous supervision to control the data collection procedure by the principal investigator.

Data management and analysis

The data were checked for clarity, completeness, and consistency. Epi-Data version 4.6 and SPSS version 20 were used for data entry and analysis, respectively. The descriptive statistics were presented using texts, frequency tables, graphs, mean, and percentages. Bivariable and multivariable logistic regression analysis was performed to identify independently associated factors of dysmenorrhea. One-way analysis of variance (ANOVA) test of association was applied to examine the mean difference in academic performance among students with and without dysmenorrhea. Variables with a p-value of ≤ 0.25 in the bivariable regression analysis were included in the final model. The strength of association was interpreted using adjusted odds ratios with a 95% confidence interval and the Hosmer-Lemeshow goodness-of-fit was applied to test for model fitness. Statistically significant variables were declared at a p-value of ≤ 0.05.

Measurement

Dysmenorrhea: was considered if the girl had painful menstruation, unable to perform daily activities, and needs medical management or self-medication to control pain for the past 6 months (19, 22).

Academic performance: the self-reported cumulative grade point average (CGPA) of students were used as a proxy measure of academic performance (23).

The multi-dimensional Scoring system (MSS): is a scoring system that grades pain severity and took into account the impact of pain on daily activities, systemic symptoms, and analgesic requirements (24).

Grade 0 (No dysmenorrhea): menstruation is not painful and daily activities are not affected.

Grade 1 (Mild): menstruation is painful but seldom inhibits normal activity. Pain killers are rarely required.

Grade 2 (Moderate): painful period and affects daily activities. Pain killers are required; however, they give sufficient relief so that absence from class is unusual.

Grade 3 (Severe): is a painful menses that severely limit normal daily activities and results in noticeable symptoms (such as headache, fatigue, vomiting, and diarrhea) and refractory to analgesics.

Patient and public involvement

There was no patient and public involvement in the design and planning of this study.

Ethical consideration

Ethical approval was obtained from the institutional review board of Hawassa University, college of medicine, and health science (Ref. No: IRB/210/11). Verbal informed consent was obtained from the study participants. Data was kept confidential and anonymous and was used only for research purposes.

Result

A total of 615 female students participated in the study, making a response rate of 95.1%. Thirteen (2.0%) respondents had a lack of interest and shortage of time, and the rest 19(2.9%) questionnaires were found to be incomplete and excluded from the analysis.

Socio-demographic characteristics of participants

The age of the participants ranged from 18-29 years with the mean age of 21.68±2 (SD) years and more than half 380(61.8%) of the respondents were found in the age range of 21 - 25 years. Most of the respondents 422(68.6%) were followers of Orthodox Christianity and three-fourth, 462(75.1%) of students earn more than 301 Ethiopian birrs per month (Table 1).

Table 1: Sociodemographic characteristics of the respondents.

Variables	Category	Frequency (n=615)	Percent (%)
Age	15 - 19 years	31	5.0
	20 – 24 years	523	85.0
	25 – 29 years	61	10.0
Residence	Urban	374	60.8
	Rural	241	39.2
Religion	Orthodox	422	68.6
	Muslim	77	12.5
	Protestant	102	16.6
	Others*	14	2.3
Marital status	Single	541	88.0
	Married	66	10.7
	Divorced & widowed	8	1.3
Fathers education	Unable to read and write	64	10.4
	Able to read and write	163	26.5
	1^{st} – 8^{th} grade	102	16.6
	9^{th} – 12^{th} grade	80	13.0
	College and above	206	33.5
Mothers education	Unable to read and write	142	23.1
	Able to read and write	146	23.7
	1^{st} – 8^{th} grade	104	16.9
	9^{th} – 12^{th} grade	96	15.6
	College and above	127	20.7
Family size	≤ 4	106	17.2
	5 – 8	450	73.2
	≥ 9	59	9.6
Average monthly stipends	≤ 150 ETB	31	5.0
	151 – 200 ETB	50	8.2
	201 – 300 ETB	72	11.7
	≥ 301 ETB	462	75.1

ETB- Ethiopian Birr Others*- Catholic, Adventist, Hawariyat

Psychosocial and contraception history

About one-fifth of respondents 114(18.5%) had previous attempts to lose weight, and 87(75.6%) of them performs an exercise to reduce weight. More than two-thirds (11.4%) of participants had used contraception. Of these, 36(51.4%) used Pills followed by 22(31.4%) injectable (Table 2).

Table 2: Psychosocial characteristics and contraception use of respondents.

Characteristics	Category	Frequency (n=615)	Percent (%)
History of attempts to lose weight	Yes	114	18.5
	No	501	81.5
Type of activities done to reduce weight (n=114)	Regular exercise	87	75.6
	Diet correction	18	15.1
	Both exercise and diet	6	5.9
	Other*	3	3.4
Exam/test/assignment related stress	Yes	315	51.2
	No	300	48.8
Disruption of social networks either family, friends or fiance	Yes	282	45.9
	No	333	54.1
Contraceptive use	Yes	70	11.4
	No	545	88.6
Type of contraception used	OCPs	36	51.4
	Injectable	22	31.4
	Implants	9	12.9
	IUCD	3	4.3
Duration of contraception use (n=70)	< 3 months	22	31.4
	3-6 months	14	20.0
	6-12 months	25	35.7
	> 1 years	9	12.9

Other*- Dancing, doing home works, drinking hot water and lemon

Lifestyle and behavioral characteristics

About three-forth (76.9%) of participants did not involve in any physical activity. Three hundred forty-nine (56.7%) students drink one or two cups of coffee per day. More than two-thirds (70%) of them do not consume alcohol at all. Nearly half (48.8%) of students drink Coca-Cola/Pepsi 2-3 times per week. About 378(61.5%) and 430(69.9%) of students get adequate sleep per night and eat breakfast more than five days per week, respectively (Table 3).

Table 3: Lifestyle and behavioral characteristics of participants.

Characteristics	Category	Frequency (615)	Percent (%)
Physical activity	Not at all	473	76.9
	< 5	115	18.7
	≥ 5	27	4.4
Cups of coffee taken per day	Not at all	244	39.7
	< 3	349	56.7
	≥ 3	22	3.6
Glasses of tea taken per day	Not at all	86	14.0
	< 4	506	82.3
	≥ 4	23	3.7
Teaspoons of sugar used per day	No at all	115	18.7
	Minimal	430	69.9
	Moderate	62	10.1
	Excessive	8	1.3
Alcohol consumption	Not at all	432	70.2
	2-3 times per month	167	27.2
	2-3 times per day	5	0.8
	I drink daily	11	1.8
Smoking	Not at all	598	97.2
	2-3X per month	11	1.8
	2-3 times per week	2	0.3
	Once per day	1	0.2
	More than one per day	3	0.5
Khat use	Not at all	595	96.7
	2-3X per month	13	2.1
	Once a week	3	0.5
	2-3X per week	1	0.2
	Daily	3	0.5
Coca-Cola/Pepsi use	Not at all	244	39.7
	2-3x per week	300	48.8
	Once per day	64	10.4
	More than one/day	7	1.1
Chocolate consumption	Not at all	352	57.2
	2-3 bars per week	214	34.8
	Two bars/day	29	4.7
	More than two bars/day	20	3.3
Sleeping hours	Inadequate (< 7 hrs.)	237	38.5
	Adequate (≥ 7 hrs.)	378	61.5
Breakfast per week	Not at all	20	3.3
	< 5	165	26.8
	≥ 5	430	69.9

Reproductive and menstrual characteristics

The mean age at menarche was 14.61±1.73 years ranging from 9-18 years. More than two-thirds of 469(76.3%) students experienced menarche in the age group of 13-16 years. Two-third of 410(67%) respondents had regular menstrual cycles, and 588(95.6%) of them had three to seven days of menstrual flow (Table 4).

Table 4: Reproductive and menstrual characteristics of respondents.

Characteristics	Category	Frequency(n=615)	Percent (100%)
Age at menarche	≤ 12 years	67	10.9
	13 - 16 years	469	76.3
	≥ 17 years	79	12.8
Number of children	Not at all	593	96.4
	1	17	2.8
	≥ 2	5	0.8
Menstrual cycle pattern	Regular	410	66.7
	Irregular	205	33.3
Menstrual cycle length in days (n=410)	≤ 20 days	2	0.5
	21–35 days	405	98.8
	≥ 36 days	3	0.7
Duration of flow	≤ 2 days	22	3.6
	3-7 days	588	95.6
	≥ 8 days	5	0.8
Amount of menstrual blood	Light	41	6.7
	Moderate	559	90.9
	Heavy	15	2.4
Family history of dysmenorrhea	Yes	259	42.1
	No	356	57.9
Sexual intercourse	Yes	160	26.0
	No	455	74.0

Prevalence of dysmenorrhea

Nearly half of 317(51.5%) students had some degree of dysmenorrhea.

Associated factors of dysmenorrhea

The variables; age, residence, parents' educational status, monthly stipend, attempt to lose weight, exam/test/assignment related stress/tension, family history of dysmenorrhea, contraception use, disruption of social network either family, friends or fiance, physical activity, coffee drinking, alcohol consumption, Coca-Cola/Pepsi use, chocolate consumption, sleeping hours, breakfast intake, menstrual cycle pattern and length, and heavy menstrual periods were included in the multivariable regression model.

There is a 37% less risk of dysmenorrhea among students who skip breakfast (eat <5 days/week) compared to those who eat daily (AOR (95% CI) = 0.63(0.42-0.95)). However, the risk of dysmenorrhea was 2 times more prevalent among students whose father were unable to read and write (AOR (CI) =2.64(1.04-6.66)) and who had irregular menstrual cycles (AOR (CI) = 2.34(1.55-3.54)), and 3 times common among students who consume two bars of chocolate per day (AOR (CI= 3.39(1.28-8.93)), and who had a family history of dysmenorrhea (AOR (CI) = 3.29(2.25-4.81)) (Table 5).

Table 5: Bivariable and multivariable analysis of associated factors of dysmenorrhea.

Variables	Categories	Dysmenorrhea		COR (95% CI)	AOR (95% CI)
		Yes (%)	No (%)		
Fathers education	Unable to read & write	31(48.4)	33(51.6)	0.94(0.54-1.65)	**2.64(1.04-6.66) ***
	Able to read & write	75(46)	88(54)	0.85(0.57-1.29)	1.69(0.82-3.48)
	1st – 8th grade	59(57.8)	43(42.2)	1.37(0.85-2.21)	**2.08(1.02-4.26) ***
	9th – 12th grade	49(61.2)	31(38.8)	1.58(0.93-2.68)	**2.64(1.35-5.15) ****
	College and above	103(50)	103(50)	1	1
Attempt to lose weight	Yes	74(64.3)	41(35.7)	1.91(1.25-2.91)	1.52(0.90-2.56)
	No	243(48.6)	257(51.4)	1	1
Physical activity	Yes	82(57.7)	60(42.3)	1	1
	No	235(49.7)	238(50.3)	0.72(0.50-1.06)	0.91(0.57-1.45)
Coca-Cola /Pepsi use	Not at all	114(46.7)	130(53.3)	1	1
	2-3X per week	166(55.3)	134(44.7)	1.41(1.01-1.98)	1.33(0.89-2.00)
	≥ 1 per day	37(52.1)	34(47.9)	1.24(0.73-2.11)	1.19(0.61-2.35)
Chocolate consumption	Not at all	166(47.2)	186(52.8)	1	1
	2-3 bars per week	119(55.6)	95(44.4)	1.4(0.99-1.98)	1.31(0.86-2.00)
	Two bars/day	21(72.4)	8(27.6)	2.94(1.27-6.82)	**3.39(1.28-8.93) ***
	> 2 bars/day	11(55)	9(45)	1.37(0.55-3.39)	2.17(0.68-6.91)
Stress	Yes	176(55.9)	139(44.1)	1.43(1.04-1.96)	1.13(0.78-1.64)
	No	141(47)	159(53)	1	1
Breakfast intake per week	Not at all	9(45)	11(55)	0.69(0.28-1.7)	0.74(0.25-2.17)
	< 5	75(45.5)	90(54.5)	0.71(0.49-1.01)	**0.63(0.42-0.95) ***
	≥ 5	233(54.2)	197(45.8)	1	1
Sleeping hours	< 7 hrs.	112(47.3)	125(52.7)	0.76(0.55-1.05)	0.80(0.55-1.17)
	≥ 7 hrs.	205(54.2)	173(45.8)	1	1
Menstrual cycle pattern	Regular	185(45.1)	225(54.9)	1	1
	Irregular	132(64.4)	73(35.6)	2.2(1.56-3.11)	**2.34(1.55-3.54) ****
Amount of menstrual blood	Light	17(41.5)	24(58.5)	1	1
	Moderate	288(52.6)	260(47.4)	1.56(0.82-2.98)	1.37(0.67-2.88)
	Heavy	12(46.2)	14(53.8)	1.21(0.45-3.26)	0.66(0.20-2.12)
Family history	Yes	178(68.7)	81(31.3)	3.43(2.45-4.81)	**3.29(2.25-4.81) ****
	No	139(39)	217(61)	1	1

* Statistically significant at P<0.05 ** Statistically significant at P<0.01

Academic performance

The mean cumulative grade point average (CGPA) of participants was 2.93 (SD ± 0.48). Two-third (66%) of students had a CGPA of ≥2.75 and 51.7% of students had above the mean CGPA. The mean CGPA of dysmenorrheic students was lower by 0.04 compared to non-dysmenorrheic students. However, the ANOVA test of association revealed that the mean CGPA of students has no statistically significant difference between groups (F (3,611) = 1.276, p = 0.28)). Therefore, there was no statistically significant difference in academic performance between students with and without dysmenorrhea (Table 6).

Table 6: ANOVA test of association for dysmenorrhea and academic performance.

	Sum of squares	**df**	**Mean Square**	**F**	**Sig.**
Between groups	0.878	3	0.293	1.276	0.282
Within groups	140.064	611	0.229		
Total	140.941	614			

Discussion

In this study, the prevalence of dysmenorrhea was 51.5%, 95% CI (47.6-55.1). The educational status of the father, family history of dysmenorrhea, chocolate consumption, daily breakfast intake, and irregular menses were associates of dysmenorrhea. Further, there was no statistically significant association between dysmenorrhea and academic performance.

The prevalence of dysmenorrhea in the present study was consistent with studies reported from Malaysia (51.5%) (25), and Georgia (52%) (6). However, it was lower than 66.8% in Debre Berhan, Ethiopia (18), 89% in Greece (26), 62.5% in India (27), 74.8% in Spain (28), and 87.7% in Turkey university students (29). The difference may account for the lack of a universally accepted, standard definition of dysmenorrhea. They are diagnosed merely based on a student's perception of pain, which is difficult to quantify and might be caused by non-menstrual events. Besides, it may be a result of the socioeconomic and cultural differences in individuals' pain perception, and lifestyle factors.

Moreover, the study found a higher prevalence of dysmenorrhea than 45% among Indian young college students (30). This might be due to the differences in age variations and sample size. In an Indian study, the age group of students ranges from 18 to 21. However, in this study, the age group ranges from 18-29. The highest episode of dysmenorrhea occurs between the ages of 20-24 years (31). Besides, it included only 116 students from a single department and studied only primary dysmenorrhea. Such small samples might have suffered from participants without risk factors i.e. family history.

The result of this study confirmed a statistically significant association between the educational status of the father and dysmenorrhea. There is 2 times increased odds of developing dysmenorrhea among students whose fathers were unable to read and write with reference to those whose fathers have attended college and above. A similar result was obtained from Poland university students in which a decreased incidence of dysmenorrhea with paternal education was reported (32). This could be related to poor socioeconomic status and lower living standards, which in turn impose bad living conditions and lifestyles. Additionally, the studies used a similar design, setting, data collection techniques, and comparable age group of participants. Again, the same assessment tool (Andersch and Milsom scale) was used.

The study identified chocolate consumption as an important determinant factor for dysmenorrhea. The risk was three times more common among students who consume two bars of chocolate per day compared to those who do not consume at all. Similarly, a systematic review of observational studies stated that excessive sugar intake creates pain in the menstrual cycle (33). This was also represented in Debre Markos town in which dysmenorrhea was three times higher among students with excessive sugar intake (21). This might be explained by, the high sugar content compromises the absorption and metabolism of important vitamins and minerals, causing a muscle spasm, which can be manifested by menstrual pain (19). Besides, it may be a result of the precursors of prostaglandins, which are the cause of dysmenorrhea, which might be found in sugar-containing meals (21).

It was found that skipping breakfast lowers the risk of dysmenorrhea by 37%. This might be due to socio-economic, cultural, religious, and personal factors other than breakfast skipping that contributed to dysmenorrhea. However, a study among university students of Palestine reported two times increased risk of dysmenorrhea among students who skip breakfast (34). This could be due to the study assessed those who never/sometimes eat breakfast. But, in this study, we assessed those who sometimes skips breakfast (≤4 days per week). Hence, never/sometimes eating breakfast might have resulted in poor nutrient absorption that may lead to irregular menses and increased pain intensity (35). In another way, in Spain, breakfast skipping has no significant association with both menstrual pain and intensity of the pain (36). This requires further research for clarification.

In this study, a statistically significant association between irregular menstrual cycles and dysmenorrhea was observed. A similar result was obtained in a study published in Ghana (37). Additionally, a study from Palestine indicated that students who have irregular menstrual cycles were approximately two times more likely to experience dysmenorrhea (34). This can be obviously due to the hyperproduction of prostaglandins by the endometrium, which results in increased uterine contractions and arterial vasoconstriction, causing ischemic pain.

Additionally, a positive family history of dysmenorrhea was found to be a strong determinant of the higher burden of dysmenorrhea. Similarly in Serbia, students with a family history were three times more likely to suffer from the problem (38). Again it was also reported from Debre Markos (21), Mekelle (9), Spain (28), and systematic reviews conducted on both developing and developed

countries (39). The possible explanation may be related to genetic factors and the risk of other hereditary causes such as endometriosis.

Finally, the association between dysmenorrhea and academic performance was examined. The mean CGPA of dysmenorrheic students was lower by 0.04 compared to non-dysmenorrheic students. However, there was no statistically significant difference in academic performance between students with and without dysmenorrhea. A comparable result was reported from Debre Berhan, Ethiopia (40). Similarly, a study in Spain reported that dysmenorrhea does not correlate with the quality of life of university students (13). However, a systematic review and meta-analysis in low- and middle-income countries concluded that dysmenorrhea has a statistically significant negative influence on academic performance both at school and during higher education (41). Besides, dysmenorrhea was observed to cause absenteeism, and hence a negative impact on academic performance (42, 43). Further, another study in Ethiopia established a statistically significant negative association (18). This inconsistent result might be due to the study measured only 6-month students' menstrual status despite the use of CGPA, which might be affected by previous semesters or years grade. Besides, it might be due to the differences in respondents' age and operationalization of dysmenorrhea. The prevalence of dysmenorrhea decreases after 25 years of age (31), where the age in the systematic review and meta-analysis study ranges from 13 to 23 years, but in this study, it was 18 to 29 years. The decreasing burden of the problem may result in non-significant consequences. Further, the above studies measured academic performance with respect to class absenteeism, class concentration, and lack of focus on exam. However, this study used CGPA as a proxy measure of academic performance, which could be greatly responsible for the disparity.

Limitations

The study has certain limitations. First, self-administered data collection was applied that might add social desirability bias. However, anonymity and confidentiality were assured to reduce such bias. Second, the nature of self-perceived reporting may have resulted in recall bias and over/under-reporting of some variables. Third, no differentiation was made in the type of dysmenorrhea suffered by the students. Besides, other confounders like presence of disease/illness were not considered in this study.

Conclusion and recommendation

Dysmenorrhea was a common health problem among graduating University students. The educational status of the father, chocolate consumption, irregular menses, family history, and skipping breakfast had a statistically significant association with dysmenorrhea. Dysmenorrhea has no statistically significant impact on the academic performance of university students.

Reproductive health officers should educate and sensitize the community to minimize the use of high sugar-containing snacks, i.e. chocolate, and support students to have a regular follow up of their menstrual pattern and seek care in case of irregular periods. Further longitudinal studies are recommended to establish a causal relationship. Similar studies, with various study designs and measurements, should be conducted in different settings for more representative findings, which will help design interventional activities targeted at improving student's health and academic performance.

Abbreviations and acronym

AOR: Adjusted Odds Ratio

COR: Crude Odds Ratio

CI: Confidence Interval

CGPA: Cumulative Grade Point Average

MSS: Multidimensional Scoring System

OR: Odds Ratio

SRS: Simple Random Sampling

SPSS: Statistical Package for Social Sciences

WHO: World Health Organization

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Author's contribution

MT conceived and designed the proposal, performed analysis, and prepared the final draft. GA followed the data collection process and provided basic comments. AK and AA approved the proposal, critically revised, and made basic adjustments to the final paper. All authors read and approved the manuscript.

Competing interests

The authors declared no conflict of interest.

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Data sharing

Essential data used for the conclusion are included in the manuscript. The original raw data analyzed is available from the corresponding author and can be presented upon a reasonable request.

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STROBE Statement—checklist of items that should be included in reports of ***cross-sectional studies***

	Item No.	Recommendation	Page No.
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 5
Methods			
Study design	4	Present key elements of study design early in the paper	Page 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 6
Participants	6	Give the eligibility criteria, and the sources and methods of selection of participants	Page 6 and 7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 8
Bias	9	Describe any efforts to address potential sources of bias	Page 20
Study size	10	Explain how the study size was arrived at	Page 6

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 7 and 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 7
		(*b*) Describe any methods used to examine subgroups and interactions	Page 7
		(*c*) Explain how missing data were addressed	Page 7 and 9
		(d) If applicable, describe analytical methods taking account of sampling strategy	Page 6
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 9
		(b) Give reasons for non-participation at each stage	Page 9
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 9
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	Page 15 and 16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 15 and 16
		(*b*) Report category boundaries when continuous variables were categorized	Page 16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	

Continued on next page

Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 18-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 22

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.